Hartfield Place SHD

Engineering Services Report

for

Strategic Housing Development Application

at Swords Road, Whitehall.

Doc No. HARTPL-JOR-SM-ZZ-RP-C-9001_D

Prepared by:

jor Joseph O'Reilly
Consulting Civil & Structural Engineers

March 2022

Unit 1, St. Therese's Place, Flowerhill, Navan, Co Meath.
Phone: 046-9077032 Fax: 046 9077932, e-mails: mail@jor.ie

1.0 Contents

1.0 Introduction

1.1 Background

JOR Consulting Engineers were appointed by the applicant to provide an engineering services report for a Strategic Housing Development planning application at Hartfield Place, Whitehall, Swords Road, Dublin 9. The subject site has existing approved planning, planning application 3269/10 (extended by DCC – Ref. 3269/10x01) for 374 units which includes a recent approved planning application amendment to increase Block F units.

This report aims to consider the main engineering elements involved with the proposed SHD application for the development of the apartment scheme, including the following:

- Impact on existing surface water network
- Impact on existing Foul network
- Impact on existing Water main network

1.2 Proposed Development

Eastwise Construction Swords Limited intend to apply to An Bord Pleanála for permission for a Strategic Housing Development on a site at Swords Road, Whitehall, Dublin 9 (to be known as Hartfield Place). The proposed development will consist of the construction of 7 no. apartment blocks, ranging in height up to 8 storeys (over single level basement). This will provide 472 no. residential units (comprising 32 no. studios, 198 no. 1 beds, 233 no. 2 beds, and 9 no. 3 beds). All with associated private balconies/terraces to the north/south/east/west elevations. A creche (c.445.76sqm), a café unit (c.99sqm), and internal residential amenity space (c.511sqm), providing a sun lounge, gym, screening room, lounge, and meeting rooms, will also be provided.

The proposed development will include 337 no. car parking spaces, 982 no. cycle parking spaces, and 14 no. motorcycle spaces at basement/surface levels, public open space, and communal open spaces at ground and roof levels.

1.3 Existing Services Summary

The existing services (surface water, foul, watermain & basement drainage) layout & design will not be affected by the proposed increase in unit numbers and revised site

layout. The surface water network will be the same as the previously approved/accepted network by Dublin City Council. The foul network layout has been revised as agreed with Irish Water so that the whole site discharges out to the existing High Park Foul main. The design was reissued to Irish Water for design vetting - Refer to Appendix E for statement of design acceptance. Similarly the watermain network was approved/accepted previously by Irish Water will not be affected by the proposed increase in units. The basement drainage layout will stay the same.
Construction work commenced on site in September 2020 with site enabling works carried out which included installation of some site services and part of the access road north of Block A to north of Block F. The surface water network along this section of road was installed along with the surface water & foul outfalls to the High Park housing development boundary.

For information purposes the following content of the report has been retained to provide information on the developments infrastructure.

1.4 ABP Opinion – DCC Drainage Division_Response

A response to DCC drainage division's opinion was issued and discussed with DCC Senior Executive Engineer Niamh Fitzgerald. The response is located in Appendix A below and was deemed acceptable in principle. Refer to Appendix B for email confirmation.

2.0 Surface water Drainage

2.1 Previously approved design

The approved surface water network for DCC Reg. Ref 3269/10 consisted of two separate networks with two different outfalls. Each network consisted of storm drainage, slung drainage from basement roof slab, basement drainage system, SUDS features, stormbloc attenuation system, downstream defender and a hydrobrake. The SUDS features were made up of bioretention areas, green roofs, permeable paving & filter drains. The total attenuation storage provided was 1690m³. The total discharge rate for the site was 5.6l/s which equates to 2l/s/ha. The discharge for the outfall onto the Swords Road was restricted to 1.6 l/s as from the GDSDS 2031 System Performance Assessment Report, the 300mm dia public surface water main was found to be under the risk of surcharging. The discharge for the outfall into High Park was restricted to 4.0 l/s.

2.2 Proposed Surface Water System

The currently approved surface water system is the same to the previously approved system (DCC Reg. Ref.3269/10) in that it will consist of two separate networks with two different outfalls, containing surface water drainage, slung drainage, basement drainage, SUDS features and an underground attenuation system. The main difference is that the attenuation tanks will be concrete tanks and not stormbloc cells. The surface water network will connect to a new manhole which will be installed on the existing 300mm dia storm main in the Swords Road. The surface water outfall to Swords Road will have a discharge rate of 1.6l/s which is the same as the extant planning. The outfall discharging into the existing surface water main in High Park will connect into an existing manhole and will have a discharge rate of 4.0l/sec. The greenfield run-off rate for the site, in accordance with the requirements of the GDSDS, is 18.35l/s and is considered too high to use. Refer to drawing HARTPL-JOR-SM-ZZ-DR-C-0002 for surface water drainage layout and attached longsections.

The proposed revised design has been accepted in principle by Dublin City Council. The surface water layout was issued formally to Dublin City Council as part of the pre-commencement compliance to condition 8 of the extant planning conditions and subsequently been accepted in principle – Refer to Appendix B for confirmation email.

2.3 SUDS

The proposed developments revised drainage system has been designed in accordance with the principles of Sustainable Urban Drainage Systems (SUDS) and in compliance with the principles outlined in the Greater Dublin Strategic Drainage Study. The following SUDS features were selected as being suitable to manage the surface water for the approved planning application DCC Reg. Ref 3269/10:

- Green Roofs
- Rain gardens/Podium Green Areas over basement carpark
- Landscaped Areas/green gardens
- Permeable Paving parking spaces & footpaths
- Filter drains/Infiltration strips alongside impermeable surfaces where applicable
- Tree pits

The proposed SuDs measures will reduce the quantity and improve the quality of water discharging into the existing public storm main. Also the proposed SuDs measures provide a minimum of two stage treatment train approach including interception and primary/secondary treatment of surface water run-off. This treatment approach is in line with The CIRIA SuDS Manual C753.

The below Table is a summary of the proposed SuDS measures for the development and the management train in line with the CIRIA SuDS Manual C753. The key SuDS measures for the proposed development include but not limited to greenroofs, raingardens/podium slab green areas, infiltration trenches, permeable paving, permeable surfaces, landscaped green areas and tree pits where applicable.

SuDS Component	Interception	Close to Source / Primary treatment	Secondary treatment	Teritary Treatment
Greenroof	Yes	Yes		
Raingarden / Podium green areas	Yes	Yes		
Permeable paving	Yes	Yes	Yes	
Permeable Surfaces	Yes	Yes	Yes	
Infiltration trenches		Yes	Yes	
Landscaped green areas	Yes	Yes	Yes	
Tree pits			Yes	Yes
Treatment Systems (Bypass Interceptor)		Yes	Yes	Yes

Green Roofs:

Green roofs provide ecological, aesthic and amenity benefits and intercept and retain rainfall, at source, reducing the volume of runoff and attenuating peak flows. Green roofs absorb most of the rainfall that they receive during ordinary events although they will only contribute to attenuation flows for larger events. These are proposed for approximately 73% of the roof area of each apartment block.

Raingardens/Podium Green Roof:

Raingardens/Podium green roofs provide ecological, aesthic and amenity benefits and intercept and retain rainfall, at source, reducing the volume of runoff and attenuating peak flows. Raingardens/Podium green roofs absorb most of the rainfall that they receive during ordinary events although they will only contribute to attenuation flows for larger events. The podium green roof will include landscaped areas, planters and trees planted over a drainage layer and waterproofing membrane. These are proposed for the podium slab areas in the centre of the site.

Roof Bioretention Areas:

Shallow landscaped roof planters which are underdrained with engineered soils and enhanced vegetation and planting on surface which manage and treat runoff at source, and promote biodiversity. These are proposed on the podium slab areas throughout the site and will receive some rainfall from roof downpipes.

Infiltration Trenches:

Trenches filled with permeable material and a perforated pipe surrounded in geotextile. To be located alongside impermeable services or underneath permeable paving where suitable. Also some roof water will discharge into infiltration trenches prior to reaching the mainline drainage. The function of these infiltration trenches are to treat, convey and

attenuate runoff at source whilst providing infiltration to the ground where the subgrade is suitable.

Permeable Paving (tanked system):

Porous surfacing (paving brick or open graded material) which can treat rainwater, at source, and allow infiltration through an underlying porous sub-base where water can be stored within the voids of the sub base before being slowly released through natural flow via the porous medium. A tanked permeable paving system includes an impermeable geotextile at its base. These systems will allow some form of storage for small rainfall events and can result in water evaporation and absorption in small quantities, there reducing runoff. Also permeable paving will increase the quality of water which is intercepted by the system through filtration, biodegradation, pollutant adsorption and settlement/retention of solids. It is proposed to use these systems on a large proportion of external paved areas over the basement footprint.

Permeable Paving (Outside Basement Footprint)

The permeable paving outside the basement footprint will only be tanked when in close proximity to a building. Where applicable there will be no impermeable geotextile thus providing infiltration to the ground where the subgrade is suitable. In addition to the above the permeable paving will slow down the rate of runoff from the pavement in extreme rainfall events contributing to attenuation of flows.

Tree Pits

The run-off from the roads/roofs can be directed to tree pits if applicable.

The tree pits will be filled with permeable material and a perforated pipe surrounded in geotextile. The function of these bio-retention tree pits are to treat, convey and attenuate runoff at source whilst providing infiltration to the ground where the subgrade is suitable. These are only applicable where the mainline drainage will be lower than the proposed tree root system so that the tree root system is not inundated with run-off, therefore affecting the growth of the tree.

The incorporation of the above SUDS components will provide a sustainable manner in which to disperse the surface water from the proposed development and will encourage groundwater recharge and provide treatment of runoff and subsequent improvement of discharge quality. Refer to drawing HARTPL-JOR-SM-ZZ-DR-C-0008 for SuDS Features layout.

2.4 Attenuation

There will be three attenuation storage tanks located on site, one which will be part of surface water network 1 which discharges into Swords Road and the other two will be part of surface water network 2 which discharges into High Park. The two concrete storage tanks in surface water network 2 will be connected together by a 750mm dia pipe and will act as one tank, filling together/emptying together. Attenuation volumes required for the various storm durations were calculated using Flow drainage software. The storage volume is calculated using the return period, climate change percentage, total impermeable area and the peak discharge for the site. This volume was then checked when carrying out the analysis and the network passed when testing the network against the 100 year return period. The top water level (T.W.L) for attenuation system 1 is 38.632m & attenuation system 2/3 is 39.084/39.067m. Refer to drawing HARTPL-JOR-SM-ZZ-DR-C-0007 for attenuation tank details.

Below is a summary table of the three attenuation tanks:

Surface Water Network 1	
Attenuation Tank 1	
Invert Level	37.410m
Length (internal)	102m
Width (internal)	2.9m
Depth (internal)	1.45m
Volume	429m³
Effective Depth	1.132m
T.W.L - 1 in 100 year level	38.632m

Surface Water Network 2	
Attenuation Tank 2	
Invert Level	37.776m
Length (internal)	68.775m
Width (internal)	6.3m
Depth (internal)	1.5m
Volume	650m³
Effective Depth	1.308m
T.W.L - 1 in 100 year level	39.084m

Surface Water Network 2	
Attenuation Tank 3	
Invert Level	37.700m
Length (internal)	54m
Width (internal)	6.3m
Depth (internal)	1.5m
Volume	510m³
Effective Depth	1.367m
T.W.L - 1 in 100 year level	39.067m

2.5 Design Standards

All services have been designed in accordance with the Greater Dublin Regional Code of Practice for Drainage Works and the Department of Environment 'Recommendations for site development works for Housing Areas'. The drainage network has been designed to cater for 100 year storms and for 20% additional increase for climate change for each pipe run.

The surface water network was designed using the below parameters to size the pipes for a 5 year storm event.

- Return period 5 years (flooding check for 30 year event)
- Time of entry 5 minutes
- Pipe Friction 0.6mm

- Minimum velocity 1.0m/s
- Standard Average Annual Rainfall 929mm
- M5-60 16.3mm
- Ratio r 0.300
- Climate Change 20% for rainfall intensities

Surface water sewers have been designed in accordance with IS EN 752 and the recommendations of the 'Greater Dublin Strategic Drainage Study', (GDSDS).

2.6 Contributing Areas

The below table shows a breakdown of the contributing areas for the proposed site. The runoff coefficient for each area was then factored in resulting in a total of 1.734ha of impermeable area on the proposed site.

Contributing Areas - Whole Site			
	Area (ha)	Runoff Coefficient	Effective Area (ha)
Proposed Road - Impermeable surface	0.043	0.90	0.039
Proposed Road - Permeable surface	0.244	0.80	0.195
Proposed Impermeable surfaces	0.162	0.80	0.130
Proposed Carparking Spaces - Permeable paving =	0.087	0.50	0.044
Landscaped areas outside of basement footprint	0.685	0.40	0.274
Proposed footpaths - Impermable	0.256	0.80	0.205
Reinforced Grass area	0.030	0.40	0.012
Multi Games courtyard - Impermeable	0.037	0.80	0.030
Basement Vents	0.044	0.40	0.018
Green Roofs - Accessible	0.034	0.70	0.024
Green roofs - accessible for maintenace only	0.445	0.70	0.312
Ballast roof - accessible for maintenace only	0.125	0.90	0.113
Podium slab - Landscape/Green areas	0.327	0.70	0.229
Podium Slab - Footpaths & Impermeable areas	0.125	0.90	0.113
Footpath along Swords Road	0.114	0.00	0.000
Landscape strips along Swords road	0.012	0.00	0.000
Totals	2.770		1.734
NOTE: Footpath and landscape strips along Swords road not considered to be contriburing areas			

As there is two separate surface water networks proposed for the subject site, the above contributing areas have been allocated to the relevant manholes in Flow drainage software

which was used to design the surface water network. The areas can be viewed in the flow report on the front page, under the section ‘nodes’.

2.7 Climate Change

Surface water calculation for the proposed development made use of rainfall values provided by Met Eireann. Rainfall intensities were increased by a factor of 20% to take account of climate change, as required by the GDSDS for attenuation storage design.

2.8 Storm Network Flood Analysis

Flood analysis for a 1 in 30 year and 1 in 100 year rainfall events was carried out on the revised surface network using Flow drainage design and analysis software. Flow software is a hydraulic modelling package for the design and analysis of storm water drainage networks. The results from the analysis confirm that the proposed system will operate in accordance to the design standards during a 1 in 30 year and 1 in 100 year event and does not represent a flood risk to the development. There was no flooding shown for either rainfall event where the minimum requirement is no flooding for the 1 in 30 rainfall event. The report on the flood analysis is in Appendix G.

2.9 Hydrobrake Chamber – Active Monitoring Sensor

Due to the restricted discharge required, the flow control devices installed will have a small opening to restrict the water flow to 1.6l/sec and 4.0l/sec respectively. This would increase the possibilities of a blockage occurring in the hydrobrake. To provide active monitoring of the hydrobrake it is proposed to install a Hydro-Logic Flexi Logger and sensor to actively monitor the water level inside the chamber. This will provide level updates that can be monitored and will identify if the level of water in the system is unusually high for an in-significant rainfall event. The Flexi Logger 300ex will be connected to a Pulsar DBi3 radar to sensor the level. The data can then be transmitted via GRPS to either a Telemetry WebPortal (FTP to client server available) or using DNP3 can transfer data directly to nominated clients. Refer to Appendix F for documentation on the proposed logger and sensor. This will be fixed to the underside of the hydrobrake manhole cover slab.

2.10 Site Specific Flood Risk Assessment

A site specific flood risk assessment has been carried out on the proposed development and is issued as a separate document – Document no. HARTPL-JOR-SM-ZZ-RP-C-9003.

2.11 Site Specific Flood Risk Assessment - Recommendation

A flood risk assessment was carried by Hydrocare Environmental. A possible flood risk of a neighboring property was highlighted if the proposed surface water system blocked or surcharged in the south eastern corner, south of Block G. To eliminate this risk a 225mm high level overflow pipe was proposed to be installed on the east side of attenuation tanks 2 & 3 and will discharge in to the manhole, downstream of the hydrobrake manhole. This would bypass the attenuation tanks, hydrobrake and interceptor. A suitable drainage grate would be installed at a level of 40.000m. This would allow localised flooding in this area but if the localised flooding reached a certain level it would drain into the overflow pipe therefore removing the risk of flooding to the neighboring property. Refer to surface water layout drawing HARTPL-JOR-SM-ZZ-DR-C-0002 which shows the position of the 225mm high level overflow pipe.

2.12 Surface Water Summary

To summarise, the proposed increase in units for the SHD application will not have an impact on the design or layout of the currently approved surface water system. The contributing drainage area will be reduced slightly therefore not affecting the approved design.

3.0 Foul Drainage Design

3.1 Original Foul Sewer Layout – DCC Reg. Ref. 3269/10

The original foul sewer layout which was approved in principle by Dublin City Council was divided up into three catchments with an individual outfall for each catchment. Catchment 1 includes Blocks A and B adjacent to Swords Road to the north-west of the site, Catchment 2 includes Blocks C and E adjacent to Swords Road to the south and south-west of the site. The remainder of the development – Blocks D, F and G and the crèche on the eastern side constitute Catchment 3.

Outfall 1 is to the north-west of the proposed development and connects into the existing system in Swords Road serving Catchment 1, with Outfall 2 to the south-west of the proposed development and connects into the existing system in Swords Road, serving Catchment 2 and Outfall 3 connects into the existing system in High Park, serving Catchment 3. The foul networks consisted of 150mm & 225mm gravity sewers, slung foul drainage, and basement drainage with associated pump pit in the basement.

3.2 Proposed Foul Layout

It was initially proposed to install the same foul network layout in principle as per approved extant planning (DCC Reg. Ref 3269/10) but after discussions with Irish Water it was identified that there was capacity issues in the existing foul network located in Swords Road. Various alternative options were reviewed with Irish Water to increase capacity in Swords road foul main but it was decided to discharge the whole site out to the High Park foul main. Refer to Appendix D for confirmation of feasibility letter – Refer to foul layout drawing HARTPL-JOR-SM-ZZ-DR-C-0001.

3.3 Proposed Foul Volumes

From Section 3.6 in the Irish Water Code of Practice for Wastewater, wastewater design flow rates have been applied to each unit. Refer to table 3.1 below which shows the revised foul discharge for the respective apartment blocks including the crèche, the coffee shop & communal amenity space.

Foul Discharge Table

	No. Of Units	Occupancy	l/person/day	Daily Flow (l)	Average Flow Litres /sec **DWF**	Peak Flow Litres /sec **1.25 x DWF Average Flow**	Peak Flow Litres /sec **(6xDWF) For pipe sizing only**
Block A Apartments	56	2.7	150	22680	0.26	0.33	1.58
Block B Apartments	78	2.7	150	31590	0.37	0.46	2.19
Block C Apartments	54	2.7	150	21870	0.25	0.32	1.52
Block D Apartments	76	2.7	150	30780	0.36	0.45	2.14
Block E Apartments	58	2.7	150	23490	0.27	0.34	1.63
Block F Apartments	76	2.7	150	30780	0.36	0.45	2.14
Block G Apartments	74	2.7	150	29970	0.35	0.43	2.08
Creche (Part of Block A) (Demand similar to 14 units)	14	2.7	150	5670	0.07	0.08	0.39
TOTAL	472			**196830**	**2.28**	**2.85**	**13.67**

NOTE: The peak demand for water is 1.25 times the average flow as stated in Section 3.7.2 of Irish Water Code of Practice

Foul Discharge Table - Business

Building	No. of	Occupancy	l/person/day	Daily Flow	DWF (l/s)	Peak Flow (l/s) 1.25 x DWF	6 x DWF (l/s)
Café Custor	500	1	12	6000	0.069	0.087	0.417
Staff	6	1	90	540	0.006	0.008	0.038
TOTAL				**6540**	**0.076**	**0.095**	**0.454**

Total Foul Discharge Table

Totals (Residential & Business)		**196830**		**2.35**	**2.94**	**14.12**

Table 3.1

3.4 Irish Water – Statement of Design Acceptance

Irish Water had designed vetted the proposed foul network for the proposed development– Refer to Appendix E.

4.0 Water Supply and Distribution

4.1 Original Water Layout – DCC Reg. Ref 3269/10

The watermain layout for approved for DCC Reg. Ref 3269/10 shows two connections to existing watermains, one off the existing 100mm diameter watermain located in the Swords Road and the other off the existing 100mm diameter watermain located in the existing High Park residential development. A 150mm diameter watermain loop between the two existing watermains was shown to serve the proposed development.

Below is an excerpt from Irish Waters existing services plan (Figure 4.1); the green line is the approx. outline of the proposed development – Refer to Appendix C for full plan.

Figure 4.1

4.2 Proposed Watermain Layout

It was initially proposed to install the same watermain network layout in principle as per approved extant planning (DCC Reg. Ref 3269/10) but after a design review on the existing network by Irish Water it was identified that it wasn't an option to connect to the existing 300mm watermain located in Swords Road. Irish Water provided confirmation that the site is to be supplied water by a connection made to the existing 300mm ductile iron watermain

located in Collins Ave, at the junction with Swords Road. This will involve installing approximately 180m of 200mm internal diameter watermain from Collins Avenue to the proposed developments site boundary on Swords Road. The proposed watermain layout involves the installation of a 200mm internal watermain from the connection point at the site boundary to a plant room located in the proposed basement underneath Block A – Refer to watermain layout drawing HARTPL-JOR-SM-ZZ-DR-C-0003. Each proposed apartment block will have its own individual supply from the proposed plant room. A proposed fire water ring main is to be installed around the site to supply proposed fire hydrants. Irish Water have designed vetted the proposed watermain network for the proposed development and provided a statement of design acceptance – Refer to Appendix E.

4.3 Proposed Water Demand Quantities

From Section 3.7.2 in the Irish Water Code of Practice for Water, the average daily domestic demand shall be based on a per-capita consumption of 150 l/person/day and an average occupancy ratio of 2.7 persons per dwelling. Refer to table 4.1 below which shows the water demand for the whole site incorporating the amended number of units for the SHD application.

Water Demand Table

	No. Of Units	Occupancy	l/person/day	Daily Flow (l)	Average Flow Litres /sec **DWF**	Peak Flow Litres /sec **1.25 x DWF Average Flow**	Peak Flow Litres /sec **(5xDWF) For pipe sizing only**
Block A Apartments	56	2.7	150	22680	0.26	0.33	1.31
Block B Apartments	78	2.7	150	31590	0.37	0.46	1.83
Block C Apartments	54	2.7	150	21870	0.25	0.32	1.27
Block D Apartments	76	2.7	150	30780	0.36	0.45	1.78
Block E Apartments	58	2.7	150	23490	0.27	0.34	1.36
Block F Apartments	76	2.7	150	30780	0.36	0.45	1.78
Block G Apartments	74	2.7	150	29970	0.35	0.43	1.73
Creche (Part of Block A) (Demand similar to 14 units)	14	2.7	150	5670	0.07	0.08	0.33
TOTAL	472			**196830**	**2.28**	**2.85**	**11.39**

NOTE: The peak demand for water is 1.25 times the average flow as stated in Section 3.7.2 of Irish Water Code of Practice

Water Demand Table - Business

Building		No. of	Occupancy	l/person/day	Daily Flow	DWF (l/s)	Peak Flow (l/s) 1.25 x DWF	5 x DWF (l/s)
Café	Custo	500	1	12	6000	0.069	0.087	0.347
	Staff	6	1	90	540			
TOTAL					**6540**	**0.069**	**0.087**	**0.347**

Total Water Demand Table

Totals (Residential & Business)		**196830**		**2.35**	**2.93**	**11.74**

Table 4.1

The maximum daily water demand for the proposed development is 196,830 l/day.

Water works for the proposed development shall be in accordance with Irish water connections and developer service code of practice for water infrastructure (A Design and Construction Guide for Developers).

4.4 Irish Water – Statement of Design Acceptance

Irish Water had designed vetted the proposed watermain network for the proposed development and issued a statement of design acceptance – Refer to Appendix E.

5.0 Basement Drainage

5.1 Basement Drainage

Any surface water from the basement carpark would drain through an underground system of collector pipes towards the lower basement southern wall. A system of gullies and ACO drains will collect water and connect into a 150mm diameter surface water pipe system which will drain through a bypass interceptor prior to discharge into a pump chamber. From the pump chamber, basement water will be pumped via a 60mm ductile iron rising main which will connect into the gravity foul drainage system for the site at ground floor level. Refer to drawing HARTPL-JOR-BT-B1-DR-C-0001 for the proposed basement drainage layout.

6.0 Appendix A – Response to ABP Opinion – Addendum B – DCC Drainage Division

The below report contains responses to items raised by DCC drainage division on the 4th of November 2021 for a proposed SHD application at Hartfield Place, Swords Road, Whitehall, Dublin 9.

- Item 1 – SuDs
- Item 2 – Attenuation Tanks
- Item 3 – Connections
- Item 4 – Taking in Charge

These items were discussed with DCC Senior Executive Engineer Niamh Fitzgerald on the 29/03/2022 and were deemed acceptable in principle.

Item 1 - SuDs

- *The development shall incorporate Sustainable Drainage Systems in the management of surface water, with a minimum requirement of a 2-stage treatment approach.*
- *Details shall be provided on how it is proposed to comply with the key surface water drainage design criteria listed under Section 16.3 of The Greater Dublin Regional Code of Practice for Drainage Works Version 6.0.*
- *Detail of the 2 – stage surface water management strategy, by SuDs, that shall be applied for each type hard standing area shall be provided. Integration with the proposed landscape proposals should be implemented.*

JOR' Response:

- Green roofing has been implemented onto each apartment block roof where applicable. Approximately 73% of available roof space will be green roofing.
- The podium slab over the basement will have a podium green area which will be landscaped as per landscape architect plan. Where applicable roof run off can discharge into raised planters or rain gardens.
- The majority of the road around the development will be a permeable pavement.
- All surface level carparking bays to be permeable paving.
- Surfaces in public open space and communal open space to be permeable (bark mulch or similar).

- Where applicable roof water to discharge to infiltration trenches prior to entering the mainline drainage.
- Road gullies to discharge to infiltration trenches where applicable.
- Tree pits to be used where drainage is below tree root systems.

The proposed SuDs measures will reduce the quantity and improve the quality of water discharging into the existing public storm main. Also the proposed SuDs measures provide a minimum of two stage treatment train approach including interception and primary/secondary treatment of surface water run-off. This treatment approach is in line with The CIRIA SuDS Manual C753.

The below Table is a summary of the proposed SuDS measures for the development and the management train in line with the CIRIA SuDS Manual C753. The key SuDS measures for the proposed development include but not limited to greenroofs, raingardens/podium slab green areas, infiltration trenches, permeable paving, permeable surfaces, landscaped green areas and tree pits where applicable.

SuDS Component	Interception	Close to Source / Primary treatment	Secondary treatment	Teritary Treatment
Greenroof	Yes	Yes		
Raingarden / Podium green areas	Yes	Yes		
Permeable paving	Yes	Yes	Yes	
Permeable Surfaces	Yes	Yes	Yes	
Infiltration trenches		Yes	Yes	
Landscaped green areas	Yes	Yes	Yes	
Tree pits			Yes	Yes
Treatment Systems (Bypass Interceptor)		Yes	Yes	Yes

Item 2 - Attenuation Tanks

In relation to the proposed attenuation tank, where there is available open space DCC's preference is for natural storage mechanisms such as ponds, detention basins etc. Only where these are shown not to be feasible will DCC accept an underground attenuation tank. Detail to be revised to meet the following –

It is not permissible to locate surface water attenuation tanks under the pavement and/ or carriageway of the proposed development. Please refer to section 16.6 of the Greater Dublin Regional Code of Practice for Drainage Works Version 6.0.

JOR's Response:

Bio-retention basins/ ponds were considered for the subject site but on review, the area required for a bio-retention basin/ pond would severely reduce the available public open space.

Unsealed stormtech systems were also considered but eliminated as an option due to the required plan area.

Please note the proposed surface water network (with attenuation tanks below the pavement) has been previously approved by DCC for compliance to the extant planning application 3269/10.

Please note the proposed development will not be taken in charge by DCC.

Item 3 - Connections

DCC Drainage Planning shall be consulted in relation to the proposals to connect to public surface water network. Details shall be agreed in writing with DCC's Drainage Planning and Developer Services Section prior to submission for SHD application. All private drainage such as, downpipes, gullies, manholes, Armstrong junctions, etc. are to be located within the final site boundary.

Details to be provided as follows –

- *Clarify detail of investigations carried out to confirm that proposed surface water connection can be constructed and that there is route, among existing services within the existing carriageway.*
- *Confirmation that the appropriate permissions to lay the proposed 225mm sewer in adjacent lands have been provided.*

JOR's Response:

The surface water outfall and foul outfall to High Park has been installed up to High Park boundary during Phase 1 Enabling works for the extant planning. There is a right of way over the section of 3rd party owned land to High Park for connections to public services only. DCC and Irish Water inspected both installation works.

The outfall to Swords road is yet to be installed. Investigation works were carried out on Swords to survey the existing services so a final route could be proved.
All private drainage will be located within the final site boundary.

Item 4 - Taking in charge

Detail of any proposed surface water within the public realm areas will be handed over to Dublin City Council for management. DCC drainage construction standards in accordance to the Greater Dublin Regional Code of Practice shall be applied to all external public spaces, to ensure they are constructed to the required standard.

JOR's Response:

Referring to CWOB Architects taking in charge drawing HARTPL-CWO-SM-00-DR-A-000506 and Aecom Drawing PR379360-ACM-XX-XX-DR-CE-20-0003, it shows an area along Swords road which will be taking in charge by DCC. The proposed development will not be taking in charge by DCC. Apart from the surface water outfalls that are outside the site boundary, all surface water infrastructure will be inside the final site boundary.

7.0 Appendix B – DCC Email Confirmation – Surface Water Layout Compliance

Surface Water network – DCC Confirmation Email

Damien O'Brien

From: Niamh Fitzgerald <niamh.fitzgerald@dublincity.ie>
Sent: 07 April 2022 10:20
To: 'Peter Cullen'; 'Joseph M O'Reilly'
Cc: Daniel Lowe; 'Damien O'Brien'
Subject: RE: L20-01 SHD application for Hartfield Place, Swords Road, Whitehall, Dublin 9; ref ABP-311749-21

Hi Peter,

Yes that is fine to include. I have no further comments to add.

Regards,
Niamh

From: Peter Cullen <peter@jor.ie>
Sent: 07 April 2022 09:55
To: Niamh Fitzgerald <niamh.fitzgerald@dublincity.ie>; 'Joseph M O'Reilly' <mail@jor.ie>
Cc: Daniel Lowe <daniel.lowe@dublincity.ie>; 'Damien O'Brien' <damien@jor.ie>
Subject: RE: L20-01 SHD application for Hartfield Place, Swords Road, Whitehall, Dublin 9; ref ABP-311749-21

Hi Niamh,

We are finalising our SHD application and I'd like to include a note from DCC stating they have reviewed the proposed storm water infrastructure with JOR and in principle DCC are happy with same. Would this be a correct statement. Please add other comments if needs be.

Kind Regards,

Peter Cullen

email: peter@jor.ie

jor Joseph O'Reilly
Consulting Civil & Structural Engineers

Unit 1, St Therese's Place
Flowerhill, Navan
Co. Meath
Tel: 046 9077032
Fax: 046 9077932
www.jor.ie

Planning Compliance Submittal – Confirmation Email

Ken Byrne

From: Daniel Lowe <daniel.lowe@dublincity.ie>
Sent: 07 September 2020 10:02
To: Ken Byrne
Subject: re: Planning Compliance - 3269/10/X1 - Condition No 8
Attachments: cover letter.pdf; SW layout.pdf; SuDS.pdf; JOR eng report.pdf

Hello Ken ,

In response to the attached compliance submission for *3269/10/x1 Condition 8*, DCC Drainage Division is satisfied with the surface water management proposals, and can confirm compliance with our requirements.

Regarding the foul and water supply proposals, they should be approved by Irish Water.

regards

Daniel Lowe | Executive Engineer | Wastewater Planning and Development Control

SLA Asset Management - Environment and Transportation

Dublin City Council, Block 1, Floor 4, Civic Offices, Wood Quay, Dublin 8, Ireland

+353 1 222 8801 | daniel.lowe@dublincity.ie | www.dublincity.ie

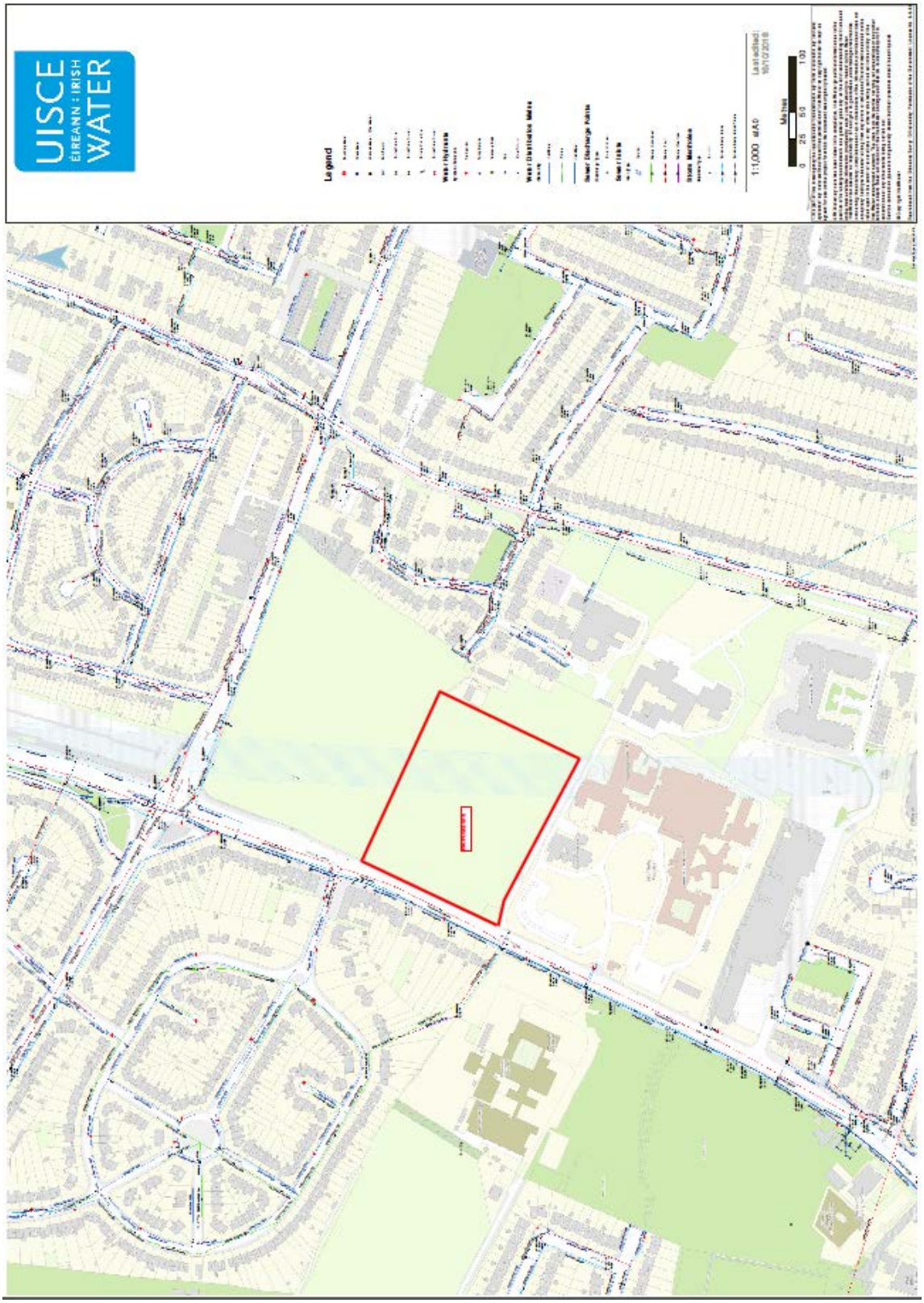
---

From: Ken Byrne <kbyrne@projectdesignarchitects.com>
Sent: 26 August 2020 11:07
To: Compliances <compliances@dublincity.ie>
Subject: Planning Compliance - 3269/10/X1 - Condition No 8

Please find attached compliance submission for condition No 8 on the above planning permission.
Any additional information required, please let me know.

Kind regards

8.0 Appendix C – Irish Water Existing Services Layout Plan



9.0 Appendix D – Confirmation of Feasibility

Fergus Lynch
Station Mews,
Lindsay Grove,
Botanic,
Dublin 9.

17 February 2022

Uisce Éireann
Bosca OP 448
Oifig Sheachadta na
Cathrach Theas
Cathair Chorcaí

Irish Water
PO Box 448,
South City
Delivery Office,
Cork City.

www.water.ie

Re: CDS19007964 pre-connection enquiry - Subject to contract | Contract denied

Connection for Multi/Mixed Use Development of 472 No. Residential unit(s), 1 No. café and 1 No. creche at the Residential Development, Hartfield Place, Swords Road, Dublin 9.

Dear Sir/Madam,

Irish Water has reviewed your pre-connection enquiry in relation to a Water & Wastewater connection at Residential Development, Swords Road, Dublin 9 (the **Premises**). Based upon the details you have provided with your pre-connection enquiry and on our desk top analysis of the capacity currently available in the Irish Water network(s) as assessed by Irish Water, we wish to advise you that your proposed connection to the Irish Water network(s) can be facilitated at this moment in time.

SERVICE	OUTCOME OF PRE-CONNECTION ENQUIRY THIS IS NOT A CONNECTION OFFER. YOU MUST APPLY FOR A CONNECTION(S) TO THE IRISH WATER NETWORK(S) IF YOU WISH TO PROCEED.
Water Connection	Feasible Subject to Upgrade
Wastewater Connection	Feasible Subject to Upgrade
SITE SPECIFIC COMMENTS	
Water Connection	The Development should be connected to the existing 300 mm DI main in Collins Avenue with a new pipe (200mm ID and approximately 180m in length). Installation of a bulk meter at the connection point of the Development is also required. Irish Water currently does not have any plans to extend or commence upgrade works to its network in this area. Should you wish to progress with the connection, the extension works will be calculated in a connection offer fee for the Development.
Wastewater Connection	In order to serve the proposed development, there may be local network upgrades required of circa 500m in length on High Park and Grace Park Road (the outline of the area is shown in the extract below). The upgrade size and or remedial works will be determined as part of the connection application phase. This local network does not have a combined sewer overflow and will not require 3rd party consents. There will be a requirement

	for a Road Opening Licence to be arranged by Irish Water upon payment of a connection offer fee for the development.

Strategic Housing Development

Irish Water notes that the scale of this development dictates that it is subject to the Strategic Housing Development planning process. Therefore:

A. In advance of submitting your full application to An Bord Pleanala for assessment, you must have reviewed this development with Irish Water and received a Statement of Design Acceptance in relation to the layout of water and wastewater services.
B. In advance of submitting this development to An Bord Pleanala for full assessment, the Developer has carried out CCTV investigations of the local network and the results of this have been used to determine the available capacity and the full extent of any upgrades which may be required to be completed to Irish Water infrastructure.

The design and construction of the Water & Wastewater pipes and related infrastructure to be installed in this development shall comply with the Irish Water Connections and Developer Services Standard Details and Codes of Practice that are available on the Irish Water website. Irish Water reserves the right to supplement these requirements with Codes of Practice and these will be issued with the connection agreement.

The map included below outlines the current Irish Water infrastructure adjacent to your site:

Reproduced from the Ordnance Survey of Ireland by Permission of the Government. License No. 3-3-34

Whilst every care has been taken in its compilation Irish Water gives this information as to the position of its underground network as a general guide only on the strict understanding that it is based on the best available information provided by each Local Authority in Ireland to Irish Water. Irish Water can assume no responsibility for and

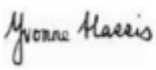
give no guarantees, undertakings or warranties concerning the accuracy, completeness or up to date nature of the information provided and does not accept any liability whatsoever arising from any errors or omissions. This information should not be relied upon in the event of excavations or any other works being carried out in the vicinity of the Irish Water underground network. The onus is on the parties carrying out excavations or any other works to ensure the exact location of the Irish Water underground network is identified prior to excavations or any other works being carried out. Service connection pipes are not generally shown but their presence should be anticipated.

General Notes:

1) The initial assessment referred to above is carried out taking into account water demand and wastewater discharge volumes and infrastructure details on the date of the assessment. **The availability of capacity may change at any date after this assessment.**
2) This feedback does not constitute a contract in whole or in part to provide a connection to any Irish Water infrastructure. All feasibility assessments are subject to the constraints of the Irish Water Capital Investment Plan.
3) The feedback provided is subject to a Connection Agreement/contract being signed at a later date.
4) A Connection Agreement will be required to commencing the connection works associated with the enquiry this can be applied for at https://www.water.ie/connections/get-connected/
5) A Connection Agreement cannot be issued until all statutory approvals are successfully in place.
6) Irish Water Connection Policy/ Charges can be found at https://www.water.ie/connections/information/connection-charges/
7) Please note the Confirmation of Feasibility does not extend to your fire flow requirements.
8) Irish Water is not responsible for the management or disposal of storm water or ground waters. You are advised to contact the relevant Local Authority to discuss the management or disposal of proposed storm water or ground water discharges
9) To access Irish Water Maps email datarequests@water.ie
10) All works to the Irish Water infrastructure, including works in the Public Space, shall have to be carried out by Irish Water.

If you have any further questions, please contact Paul Fuller from the design team on (087) 718-6226 or email PFuller@water.ie For further information, visit **www.water.ie/connections.**

Yours sincerely,



Yvonne Harris

Head of Customer Operations

10.0 Appendix E – Irish Water Statement of Design Acceptance

Damien O'Brien
JOR Consulting Engineers
Unit 1
St. Therese's Place
Flower Hill
Navan, Co Meath
C15X6CP

Uisce Éireann
Bosca OP 448
Oifig Sheachadta na
Cathrach Theas
Cathair Chorcaí

Irish Water
PO Box 448,
South City
Delivery Office,
Cork City.

www.water.ie

5 April 2022

Re: Design Submission for Residential Development, Swords Road, Dublin 9 (the "Development")
(the "Design Submission") / Connection Reference No: CDS19007964

Dear Damien O'Brien,

Many thanks for your recent Design Submission.

We have reviewed your proposal for the connection(s) at the Development. Based on the information provided, which included the documents outlined in Appendix A to this letter, Irish Water has no objection to your proposals.

This letter does not constitute an offer, in whole or in part, to provide a connection to any Irish Water infrastructure. Before you can connect to our network you must sign a connection agreement with Irish Water. This can be applied for by completing the connection application form at www.water.ie/connections. Irish Water's current charges for water and wastewater connections are set out in the Water Charges Plan as approved by the Commission for Regulation of Utilities (CRU)(https://www.cru.ie/document_group/irish-waters-water-charges-plan-2018/).

You the Customer (including any designers/contractors or other related parties appointed by you) is entirely responsible for the design and construction of all water and/or wastewater infrastructure within the Development which is necessary to facilitate connection(s) from the boundary of the Development to Irish Water's network(s) (the "**Self-Lay Works**"), as reflected in your Design Submission. Acceptance of the Design Submission by Irish Water does not, in any way, render Irish Water liable for any elements of the design and/or construction of the Self-Lay Works.

If you have any further questions, please contact your Irish Water representative:
Name: Dario Alvarez
Email: dalvarez@water.ie

Yours sincerely,

Yvonne Harris

Yvonne Harris
Head of Customer Operations

Appendix A

Document Title & Revision

- [HARTPL-JOR-SM-ZZ-DR-C-0003-C03 - (Watermain Layout)]
- [HARTPL-JOR-SM-ZZ-M2-C-0001-C03 - (Foul Layout)]
- [Foul Long sections_High Park Outfall_R02]

Standard Details/Code of Practice Exemption:
While Irish Water notes that the water and wastewater services infrastructure will remain private and not be vested, we have the following comments:

- **It is recommended that the foul sewer network is located at minimum of 3 m clearance distance from the building structure.**

For further information, visit www.water.ie/connections

Notwithstanding any matters listed above, the Customer (including any appointed designers/contractors, etc.) is entirely responsible for the design and construction of the Self-Lay Works. Acceptance of the Design Submission by Irish Water will not, in any way, render Irish Water liable for any elements of the design and/or construction of the Self-Lay Works.

11.0 Appendix F – Hydro-Logic Flexi Logger 300Ex

Technical Specification

Hydro-Logic® Flexi Logger 300Ex

Hydro International

The 300Ex is ATEX certified and so is ideal for installation in chambers or tanks where the atmosphere may be explosive.

Key Features

- ATEX and IECEx compliant (to Zone 0).
- GSM, GPRS or 3G networks.
- 3 sensor connectors suitable for field wiring.
- Remote monitoring of up to 3 HART or float switch sensors and one 4-20mA input.
- Up to 8 logged channels total, including derived channels.
- 18V sensor power supply.
- Long term secure data retention.
- Remote configuration.
- Intelligent alarms, 4 per channel.
- User-replaceable SIM card for mobile data modem.
- User-replaceable battery 96Ah.
- Battery voltage and average supply current remote monitoring.
- Integral venting for gauge pressure sensors.
- Simple and quick to install.
- Connects to Timeview or (optional) DNP3 Masters.
- IP68 enclosure is submersible to 1.2 meters for 2 days.

Hydro-Logic® Smart Monitoring

Tel: 01275 878371
smartmonitoring@hydro-int.com

Technical Specification

Hydro-Logic® Flexi Logger 300Ex

Technical Data

Sensor Inputs	4-20mA Input	• 16 bit resolution. • 0.1% accuracy. • 1 channel.
	HART Inputs	• 3 channels total.
	Digital Inputs	• 3 channels total. • 2s timing resolution. • On-off mode for float switch. • 10K internal pull-up.
Sensor Power Supply	Power Output	• Switched 18V. • 250 Ohm series resistance. • 62mA fuse (factory replaceable, ATEX requirement). • Configurable warm-up.
Data Storage	Storage Capacity	• 29,768 16-bit readings total for up to 8 channels.
	Storage Intervals	• 1m, 2m, 5m, 10m, 15m, 30m, 1h, 2h, 3h, 4h, 6h, 8h, 12h (10s and 30s available for testing) • Storage interval for each channel can be set independently. • Data recorded at cardinal points.
Communications	Transport	• Internal 3G/GPRS mobile data modem. • Local opto-isolated serial connection.
	Protocols	• Modbus ASCII. • DNP3 (support contract required).
Connectors and Switches		• 3 sensor connector plugs with 4 screw terminals. • 1 local comms connector. • 1 sensor vent with GORE® protective patch. • 1 external mobile data antenna with SMA socket. • User-accessible full-size SIM holder. • Internal dial-out button. • Externally-accessible dial-out magnetic reed switch.
Dimensions (mm)		W 169 D 145 L 174 (204 with connectors).
Construction		• Polycarbonate enclosure. • O-ring seals on all external mating surfaces. • Stainless steel bracket for wall mounting.
Protection Notes		• ATEX and IECEx Zone 0 • IECEx Certificate of Conformity - IECEx SIR16.0086X. • SIRA 16ATEX2252X.
		IP68: will withstand 1.2m immersion for 48 hours without significant ingress 1. All connectors must be tightened or have sealing caps fitted 2. Data communications may not function when immersed. 3. Gauge-pressure based level sensors are not accurate when logger enclosure is submerged.
Operating Limits		• -20 to +40°C (ATEX operating limits), 0 - 100 % Relative Humidity (RH)

Unit 1, St. Therese's Place, Flowerhill, Navan, Co Meath.
Phone: 046-9077032 Fax: 046 9077932, e-mails: mail@jor.ie

Supported Sensors			
Application	**Category**	**Manufacturer and Model**	**Recommended by Hydro***
Level	Contact	Impress LMK 307	✓
		Float switches	
	Non-contact	Pulsar dBI HART 3/6/10/15	✓
Flow / Velocity	Non-contact	Pulsar Microflow-i	✓

* All listed sensors are supported, but those marked as recommended are the most compatible with our loggers and the Harvest configuration software.

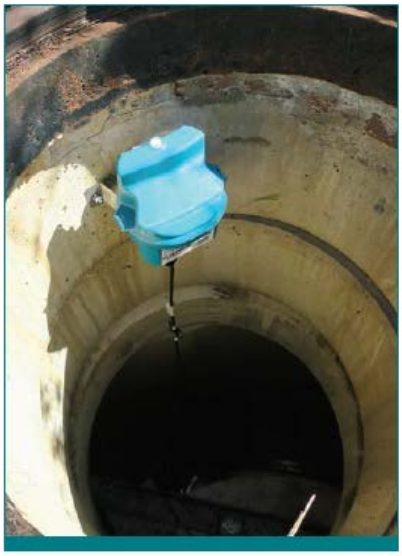
Unit 1, St. Therese's Place, Flowerhill, Navan, Co Meath.
Phone: 046-9077032 Fax: 046 9077932, e-mails: mail@jor.ie

Hydro-Logic® Flexi Logger 300Ex

ATEX certified, the Hydro-Logic® Flexi Logger 300Ex is ideal for installation in chambers or tanks where a potentially explosive atmosphere may be present.

Model Specific Features

- ATEX and IECEx compliant (to Zone 0).
- 3 sensor connectors suitable for field wiring.
- Remote monitoring of up to 3 HART or float switch sensors and one 4-20mA input.
- 18V sensor power supply.
- User-replaceable battery 96Ah battery.
- Rugged, environmental protection to IP68 (at 1.2 m submersion for 48 hours without significant ingress).



Hydro-Logic® Smart Monitoring

hydro-int.com/smartmonitoring

Unit 1, St. Therese's Place, Flowerhill, Navan, Co Meath.

Phone: 046-9077032 Fax: 046 9077932, e-mails: mail@jor.ie

Software Options

Harvest software

All our Hydro-Logic® Flexi Loggers are supplied with our Windows Harvest logger control software package. This enables users to configure all loggers, sensor and telemetry settings via serial port communications. The package also enables collected data and trends to be inspected. It is also used to export and manage data retrieved from these devices.

Harvest software is available in two versions:

- Harvest for Windows based PCs.
- Pocket Harvest for Windows Mobile based devices including the rugged Juniper Archer 2.

You can download Harvest Windows software free of charge from our support website: www.hydro-int.com/smart-monitoring-support.

Telemetry

Hydro-Logic telemetry systems provide an online platform for basic data visualisation, inspection and early warning on an annual subscription.

Automatically receiving data from remote Hydro-Logic® data loggers, Hydro-Logic® telemetry systems provide an interface to enable you to inspect data outputs, helping you to identify potential system blockages and alerting you to changes in environmental conditions that could indicate an imminent flood event.

Hydro-Logic® telemetry systems also manage any automated alerts that have been configured, distributing them via e-mail or SMS to designated recipients to provide early warning of flood events or other environmental risks.

Hydro-Logic® Timeview

Hydro-Logic® Timeview provides automatic wireless receipt of data from remote sensors, triggering automated flood event alarms, providing short-term data storage and enabling data visualisation and initial analysis.

- Capture latest data and trends.
- Reduce site visits to save cost of data collection.
- Use near real-time alarms to alert emergency staff ie. to clear blockages.
- Get warnings of events or licence compliance failure.

Hydro-Logic® Timeview DBi

Hydro-Logic® Timeview DBi is a streamlined online database for long-term data warehousing of hydrometric, climate and environmental data, equipping you with analysis tools to help you derive meaningful, actionable insights from that data.

Tel: +44 (0)1275 878371 Email: stormwater@hydro-int.com

12.0 Appendix G – Flow Drainage Analysis Results

See attached report.

Surface Water Network 1 – West Outfall

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	5	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	Scotland and Ireland	Connection Type	Level Inverts
M5-60 (mm)	16.500	Minimum Backdrop Height (m)	0.200
Ratio-R	0.300	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	✓

Simulation Settings

Rainfall Methodology	FSR	Analysis Speed	Detailed
FSR Region	Scotland and Ireland	Skip Steady State	x
M5-60 (mm)	16.500	Drain Down Time (mins)	4320
Ratio-R	0.300	Additional Storage (m³/ha)	20.0
Summer CV	0.750	Check Discharge Rate(s)	x
Winter CV	0.840	Check Discharge Volume	x

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
30	20	0	0
100	20	0	0

Node S1-11 Online Head/Flow Control

Flap Valve	x	Invert Level (m)	37.389	Design Flow (l/s)	1.6
Replaces Downstream Link	✓	Design Depth (m)	1.450		

Head (m)	Flow (l/s)
1.450	1.600

Results for 30 year +20% CC Critical Storm Duration. Lowest mass balance: 99.56%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	S1-01	10	41.158	0.158	27.5	0.3083	0.0000	OK
15 minute winter	S1-02	10	40.866	0.166	55.5	0.2581	0.0000	OK
15 minute winter	SP-1	10	41.325	0.100	13.7	0.2188	0.0000	OK
15 minute winter	S1-03	11	40.305	0.194	71.3	0.3838	0.0000	OK
15 minute winter	S1-04	11	38.942	0.242	105.9	0.4158	0.0000	OK
15 minute winter	SP-2	11	39.375	0.150	26.6	0.4789	0.0000	OK
15 minute winter	S1-05	11	38.788	0.292	120.8	0.5890	0.0000	OK
5760 minute winter	S1-06	4080	38.596	1.096	4.1	1.7684	0.0000	SURCHARGED
5760 minute winter	Tank 1 - L3	4080	38.596	1.169	4.1	0.0000	0.0000	OK
5760 minute winter	Tank 1 - L1	4080	38.596	1.096	0.8	0.0000	0.0000	OK
5760 minute winter	Tank 1 - L2	4080	38.596	1.143	1.9	0.0000	0.0000	OK
5760 minute winter	Tank 1 - L4	4080	38.596	1.198	1.5	0.0000	0.0000	SURCHARGED
5760 minute winter	S1-11	4080	38.596	1.207	1.3	1.7267	0.0000	SURCHARGED
5760 minute winter	S1-12	4080	37.394	0.031	1.3	0.0355	0.0000	OK
5760 minute winter	S1-13	4080	37.274	0.031	1.3	0.0355	0.0000	OK
5760 minute winter	S1-14	4080	37.195	0.029	1.3	0.0000	0.0000	OK
15 minute winter	SP-7	10	39.274	0.154	28.1	0.2979	0.0000	OK
15 minute winter	S1-16	11	38.740	0.240	44.8	0.4034	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	S1-01	2.000	S1-02	26.8	0.977	0.778	0.5210	
15 minute winter	S1-02	1.001	S1-03	55.2	1.648	0.855	1.2930	
15 minute winter	SP-1	1.000	S1-02	13.3	0.812	0.385	0.4517	
15 minute winter	S1-03	1.002	S1-04	71.1	2.049	0.966	1.1720	
15 minute winter	S1-04	1.003	S1-05	106.1	1.271	0.651	2.5611	
15 minute winter	SP-2	3.000	S1-04	25.7	0.976	0.746	0.8703	
15 minute winter	S1-05	1.004	S1-06	118.2	1.386	0.889	3.3828	
5760 minute winter	S1-06	1.005	Tank 1 - L3	4.1	0.353	0.031	0.8498	
5760 minute winter	Tank 1 - L3	1.006	Tank 1 - L4	1.5	0.008	0.000	98.7452	
5760 minute winter	Tank 1 - L1	5.000	Tank 1 - L2	-0.8	-0.001	0.000	153.5050	
5760 minute winter	Tank 1 - L2	5.001	Tank 1 - L3	-1.9	-0.005	0.000	87.1097	
5760 minute winter	Tank 1 - L4	1.007	S1-11	1.3	0.012	0.012	0.2838	
5760 minute winter	S1-11	Head/Flow	S1-12	1.3				
5760 minute winter	S1-12	1.009	S1-13	1.3	0.419	0.038	0.0152	
5760 minute winter	S1-13	1.010	S1-14	1.3	0.419	0.040	0.0606	461.2
15 minute winter	SP-7	4.000	S1-16	27.3	1.009	0.792	0.6720	
15 minute winter	S1-16	4.001	S1-06	44.1	1.162	1.106	0.9443	

Results for 100 year +20% CC Critical Storm Duration. Lowest mass balance: 99.56%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	S1-01	12	41.336	0.336	35.7	0.6550	0.0000	SURCHARGED
15 minute winter	S1-02	12	41.258	0.558	72.3	0.8695	0.0000	SURCHARGED
15 minute winter	SP-1	10	41.342	0.117	17.8	0.2562	0.0000	OK
15 minute winter	S1-03	11	40.592	0.481	83.0	0.9524	0.0000	SURCHARGED
15 minute winter	S1-04	11	38.982	0.282	126.7	0.4861	0.0000	OK
15 minute winter	SP-2	11	39.410	0.185	34.5	0.5916	0.0000	OK
15 minute winter	S1-05	12	38.848	0.352	145.4	0.7094	0.0000	OK
4320 minute winter	S1-06	3240	38.842	1.342	6.1	2.1654	0.0000	SURCHARGED
4320 minute winter	Tank 1 - L3	3240	38.842	1.415	6.1	0.0000	0.0000	OK
4320 minute winter	Tank 1 - L1	3240	38.842	1.342	1.2	0.0000	0.0000	OK
4320 minute winter	Tank 1 - L2	3240	38.842	1.389	3.0	0.0000	0.0000	OK
4320 minute winter	Tank 1 - L4	3240	38.842	1.444	1.9	0.0000	0.0000	SURCHARGED
4320 minute winter	S1-11	3240	38.842	1.453	1.6	2.0787	0.0000	SURCHARGED
4320 minute winter	S1-12	3240	37.397	0.034	1.6	0.0389	0.0000	OK
4320 minute winter	S1-13	3240	37.277	0.034	1.6	0.0388	0.0000	OK
4320 minute winter	S1-14	3240	37.198	0.032	1.6	0.0000	0.0000	OK
15 minute winter	SP-7	10	39.310	0.190	36.5	0.3668	0.0000	OK
15 minute winter	S1-16	11	38.893	0.393	57.9	0.6612	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	S1-01	2.000	S1-02	34.9	1.008	1.011	0.7527	
15 minute winter	S1-02	1.001	S1-03	63.8	1.665	0.987	1.5234	
15 minute winter	SP-1	1.000	S1-02	17.8	0.865	0.516	0.6487	
15 minute winter	S1-03	1.002	S1-04	81.8	2.058	1.112	1.3250	
15 minute winter	S1-04	1.003	S1-05	126.3	1.299	0.774	3.0046	
15 minute winter	SP-2	3.000	S1-04	33.2	1.038	0.963	1.0516	
15 minute winter	S1-05	1.004	S1-06	142.5	1.441	1.072	3.8580	
4320 minute winter	S1-06	1.005	Tank 1 - L3	6.1	0.389	0.046	0.8498	
4320 minute winter	Tank 1 - L3	1.006	Tank 1 - L4	1.9	0.003	0.000	119.0965	
4320 minute winter	Tank 1 - L1	5.000	Tank 1 - L2	-1.2	-0.004	0.000	187.2436	
4320 minute winter	Tank 1 - L2	5.001	Tank 1 - L3	-3.0	-0.005	0.000	105.6507	
4320 minute winter	Tank 1 - L4	1.007	S1-11	1.6	0.014	0.014	0.2838	
4320 minute winter	S1-11	Head/Flow	S1-12	1.6				
4320 minute winter	S1-12	1.009	S1-13	1.6	0.441	0.046	0.0173	
4320 minute winter	S1-13	1.010	S1-14	1.6	0.442	0.049	0.0690	494.6
15 minute winter	SP-7	4.000	S1-16	35.3	1.081	1.024	0.8063	
15 minute winter	S1-16	4.001	S1-06	57.3	1.446	1.439	0.9909	

Surface Water Network 2 – East Outfall

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	5	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	Scotland and Ireland	Connection Type	Level Inverts
M5-60 (mm)	16.500	Minimum Backdrop Height (m)	0.200
Ratio-R	0.300	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	✓

Simulation Settings

Rainfall Methodology	FSR	Analysis Speed	Detailed
FSR Region	Scotland and Ireland	Skip Steady State	x
M5-60 (mm)	16.500	Drain Down Time (mins)	4320
Ratio-R	0.300	Additional Storage (m³/ha)	20.0
Summer CV	0.750	Check Discharge Rate(s)	x
Winter CV	0.840	Check Discharge Volume	x

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
30	20	0	0
100	20	0	0

Node S2-36 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	37.698	Product Number	CTL-SHE-0095-4000-1000-4000
Design Depth (m)	1.000	Min Outlet Diameter (m)	0.150
Design Flow (l/s)	4.0	Min Node Diameter (mm)	1200

Results for 30 year +20% CC Critical Storm Duration. Lowest mass balance: 99.97%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	SP-3	10	40.269	0.144	24.4	0.4355	0.0000	OK
15 minute winter	S2-01	11	39.916	0.216	30.7	0.3039	0.0000	OK
15 minute winter	SP-4	11	41.076	0.261	45.0	0.8031	0.0000	SURCHARGED
15 minute winter	S2-02	11	39.902	0.286	79.4	0.3757	0.0000	OK
15 minute winter	SP-5	10	40.105	0.160	48.1	0.4890	0.0000	OK
15 minute winter	S2-03	11	39.630	0.350	131.2	0.5598	0.0000	OK
15 minute winter	SP-6	10	39.609	0.174	32.8	0.1574	0.0000	OK
15 minute winter	S2-04	12	39.458	0.996	169.7	1.5968	0.0000	SURCHARGED
15 minute winter	S2-05	12	38.974	0.824	214.4	1.4362	0.0000	SURCHARGED
15 minute winter	SP-8	10	39.379	0.154	28.4	0.3390	0.0000	OK
15 minute winter	S2-08	12	39.193	0.651	38.8	0.9961	0.0000	SURCHARGED
15 minute winter	S2-09	12	39.076	0.667	42.3	0.9311	0.0000	SURCHARGED
2160 minute winter	S2-09-1	2040	38.767	0.797	13.2	1.1407	0.0000	SURCHARGED
2160 minute winter	S2-10	2040	38.767	0.817	20.3	1.3507	0.0000	SURCHARGED
2160 minute winter	S2-11	2040	38.767	0.563	3.1	0.9613	0.0000	SURCHARGED
2160 minute winter	S2-12	2040	38.767	0.444	2.4	0.9918	0.0000	SURCHARGED
2160 minute winter	S2-13	2040	38.767	0.272	1.0	0.5868	0.0000	SURCHARGED
2160 minute winter	T2 - L1	2040	38.767	0.871	30.2	0.0000	0.0000	OK
2160 minute winter	T2 - L2	2040	38.767	0.942	8.1	0.0000	0.0000	SURCHARGED
2160 minute winter	T3 - L1	2040	38.767	0.964	6.5	0.0000	0.0000	OK
2160 minute winter	T3 - L2 T3 - L3	2040	38.767	1.018	23.9	0.0000	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	SP-3	1.000	S2-01	23.6	0.946	0.684	0.5241	
15 minute winter	S2-01	1.001	S2-02	29.7	0.540	0.419	1.2636	
15 minute winter	SP-4	2.000	S2-02	42.9	1.110	1.244	1.2342	
15 minute winter	S2-02	1.002	S2-03	78.0	1.239	1.099	1.6570	
15 minute winter	SP-5	3.000_1	S2-03	47.0	1.602	0.817	0.8802	
15 minute winter	S2-03	1.003	S2-04	131.0	1.351	1.177	1.7405	
15 minute winter	SP-6	4.000	S2-04	31.8	1.041	0.923	0.9178	
15 minute winter	S2-04	1.004	S2-05	166.2	1.507	1.178	6.8865	
15 minute winter	S2-05	1.005_1	S2-09-1	215.5	1.954	1.531	3.9892	
15 minute winter	SP-8	5.000	S2-08	27.6	1.012	0.800	0.9291	
15 minute winter	S2-08	5.001	S2-09	35.5	1.048	0.839	0.7953	
15 minute winter	S2-09	5.002	S2-05	42.6	1.216	0.778	0.4176	
2160 minute winter	S2-09-1	1.006	S2-10	18.9	0.880	0.114	0.3181	
2160 minute winter	S2-10	1.005	T2 - L1	30.2	2.030	0.084	0.1873	
2160 minute winter	S2-11	6.002	S2-09-1	2.9	0.326	0.018	0.7639	
2160 minute winter	S2-12	3.001	S2-11	2.4	0.548	0.034	2.0493	
2160 minute winter	S2-13	3.000	S2-12	1.0	0.304	0.025	1.1575	
2160 minute winter	T2 - L1	1.008	T2 - L2	8.1	0.035	0.000	404.3108	
2160 minute winter	T2 - L2	1.009	T3 - L1	3.2	0.733	0.006	5.8004	
2160 minute winter	T3 - L1	1.010	T3 - L3	3.4	0.025	0.000	337.1946	
2160 minute winter	T3 - L3	1.011	S2-36	23.5	0.601	0.038	0.2215	

Results for 30 year +20% CC Critical Storm Duration. Lowest mass balance: 99.97%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	S2-14	11	39.061	0.061	7.2	0.0931	0.0000	OK
15 minute winter	S2-16	11	38.824	0.094	21.0	0.1348	0.0000	OK
15 minute winter	S2-15	10	39.191	0.045	7.2	0.0698	0.0000	OK
2160 minute winter	S2-17	2040	38.767	0.255	1.0	0.3260	0.0000	OK
2160 minute winter	S2-18	2040	38.767	0.218	1.0	0.4518	0.0000	OK
2160 minute winter	S2-19	2040	38.767	0.396	2.3	0.8798	0.0000	SURCHARGED
2160 minute winter	S2-20	2040	38.767	0.937	3.8	1.3701	0.0000	SURCHARGED
15 minute winter	S2_01	10	41.789	0.058	10.0	0.0913	0.0000	OK
15 minute winter	S2-22	10	41.264	0.079	21.1	0.1300	0.0000	OK
15 minute winter	S2-23	11	40.351	0.138	68.9	0.2892	0.0000	OK
15 minute summer	S2-24	1	41.500	0.000	0.0	0.0000	0.0000	OK
15 minute winter	S2-25	11	41.081	0.081	27.5	0.1316	0.0000	OK
15 minute winter	SP-9	11	42.213	0.338	18.7	0.3768	0.0000	SURCHARGED
15 minute winter	SP-9-1	11	42.031	0.232	17.6	0.0000	0.0000	SURCHARGED
15 minute winter	SP-9-2	11	41.907	0.162	17.6	0.0000	0.0000	SURCHARGED
15 minute winter	S2-26	11	40.704	0.077	27.5	0.0867	0.0000	OK
15 minute winter	S2-27	12	38.900	0.075	7.2	0.1107	0.0000	OK
15 minute winter	S2-32	12	38.895	0.495	85.7	0.8308	0.0000	SURCHARGED
2160 minute winter	S2-33	2040	38.767	0.501	4.8	0.7026	0.0000	SURCHARGED
2160 minute winter	S2-34	2040	38.767	0.542	5.2	0.7828	0.0000	SURCHARGED
2160 minute winter	S2-35	2040	38.767	0.581	5.5	0.8176	0.0000	SURCHARGED
2160 minute winter	S2-36	2040	38.765	1.067	23.5	1.5264	0.0000	SURCHARGED
2160 minute winter	S2-Intercept	2040	37.643	0.045	4.1	0.0512	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	S2-14	7.000	S2-16	6.9	0.689	0.089	0.3857	
15 minute winter	S2-16	7.001	S2-17	20.9	0.945	0.207	0.5840	
15 minute winter	S2-15	8.000	S2-16	7.1	0.579	0.049	0.3168	
2160 minute winter	S2-17	7.002	S2-20	1.0	0.404	0.012	0.7695	
2160 minute winter	S2-18	9.000	S2-19	1.0	0.312	0.025	1.1962	
2160 minute winter	S2-19	9.001	S2-20	2.3	0.545	0.058	0.6424	
2160 minute winter	S2-20	7.003	T3 - L1	3.8	0.355	0.059	0.2103	
15 minute winter	S2_01	10.000	S2-22	9.9	0.972	0.145	0.3253	
15 minute winter	S2-22	10.001	S2-23	20.5	1.693	0.252	0.4083	
15 minute winter	S2-23	10.002	S2-32	69.1	1.906	0.703	1.6700	
15 minute summer	S2-24	11.000	S2-26	0.0	0.000	0.000	0.3101	
15 minute winter	S2-25	12.003	S2-26	27.5	2.233	0.224	0.0834	
15 minute winter	SP-9	12.000	SP-9-1	17.6	1.002	1.500	0.3017	
15 minute winter	SP-9-1	12.001	SP-9-2	17.6	0.998	1.478	0.2098	
15 minute winter	SP-9-2	12.002	S2-25	17.5	1.015	1.472	0.0580	
15 minute winter	S2-26	11.001	S2-23	27.5	1.489	0.247	0.1704	
15 minute winter	S2-27	13.000	S2-28	7.3	0.683	0.211	0.9064	
15 minute winter	S2-32	10.003	S2-33	84.3	1.197	1.078	1.8979	
2160 minute winter	S2-33	10.004	S2-34	4.8	0.536	0.059	0.5491	
2160 minute winter	S2-34	10.005	S2-35	5.2	0.558	0.072	0.6575	
2160 minute winter	S2-35	10.006	T3 - L3	5.4	0.623	0.069	0.2215	
2160 minute winter	S2-36	Hydro-Brake®	S2-Intercept	4.1				
2160 minute winter	S2-Intercept	1.013	S2-37	4.1	0.627	0.074	0.0296	

Results for 30 year +20% CC Critical Storm Duration. Lowest mass balance: 99.97%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
2160 minute winter	S2-37	2040	37.601	0.055	4.1	0.0623	0.0000	OK
2160 minute winter	S2-38	2040	37.484	0.032	4.1	0.0365	0.0000	OK
2160 minute winter	S2-39	2040	36.465	0.032	4.1	0.0000	0.0000	OK
15 minute winter	S2-28	12	38.896	0.228	14.8	0.2577	0.0000	SURCHARGED
15 minute winter	S2-29	12	38.896	0.290	12.8	0.3277	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
2160 minute winter	S2-37	1.014	S2-38	4.1	0.764	0.119	0.1159	
2160 minute winter	S2-38	1.015	S2-39	4.1	1.191	0.044	0.1077	1245.5
15 minute winter	S2-28	13.001	S2-29	12.8	0.828	0.322	0.4163	
15 minute winter	S2-29	13.002	S2-32	18.8	0.508	0.202	0.2574	

Results for 100 year +20% CC Critical Storm Duration. Lowest mass balance: 99.97%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	SP-3	12	40.411	0.286	31.6	0.8648	0.0000	SURCHARGED
15 minute winter	S2-01	12	40.353	0.653	39.8	0.9206	0.0000	SURCHARGED
15 minute winter	SP-4	11	41.242	0.427	58.4	1.3151	0.0000	SURCHARGED
15 minute winter	S2-02	12	40.328	0.712	93.7	0.9343	0.0000	SURCHARGED
15 minute winter	SP-5	12	40.418	0.473	62.4	1.4508	0.0000	SURCHARGED
15 minute winter	S2-03	12	40.097	0.817	151.4	1.3085	0.0000	SURCHARGED
15 minute winter	SP-6	12	40.083	0.648	42.6	0.5878	0.0000	SURCHARGED
15 minute winter	S2-04	12	39.945	1.483	194.6	2.3776	0.0000	SURCHARGED
15 minute winter	S2-05	12	39.282	1.132	250.4	1.9743	0.0000	SURCHARGED
15 minute winter	SP-8	12	39.703	0.478	36.9	1.0535	0.0000	SURCHARGED
15 minute winter	S2-08	12	39.582	1.040	44.9	1.5917	0.0000	SURCHARGED
15 minute winter	S2-09	12	39.421	1.012	49.4	1.4120	0.0000	SURCHARGED
2160 minute winter	S2-09-1	2040	39.049	1.079	16.0	1.5437	0.0000	SURCHARGED
2160 minute winter	S2-10	2040	39.049	1.099	18.2	1.8162	0.0000	SURCHARGED
2160 minute winter	S2-11	2040	39.049	0.845	3.6	1.4420	0.0000	SURCHARGED
2160 minute winter	S2-12	2040	39.049	0.726	3.0	1.6206	0.0000	SURCHARGED
2160 minute winter	S2-13	2040	39.049	0.554	1.3	1.1939	0.0000	SURCHARGED
2160 minute winter	T2 - L1	2040	39.049	1.153	16.7	0.0000	0.0000	OK
2160 minute winter	T2 - L2	2040	39.049	1.224	10.2	0.0000	0.0000	SURCHARGED
2160 minute winter	T3 - L1	2040	39.049	1.246	7.4	0.0000	0.0000	OK
2160 minute winter	T3 - L2 T3 - L3	2040	39.049	1.300	20.2	0.0000	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	SP-3	1.000	S2-01	30.5	1.009	0.884	0.8321	
15 minute winter	S2-01	1.001	S2-02	37.4	0.538	0.528	1.4416	
15 minute winter	SP-4	2.000	S2-02	55.4	1.400	1.607	1.2953	
15 minute winter	S2-02	1.002	S2-03	92.3	1.310	1.299	1.8801	
15 minute winter	SP-5	3.000_1	S2-03	54.4	1.616	0.947	1.1899	
15 minute winter	S2-03	1.003	S2-04	149.8	1.358	1.346	2.0098	
15 minute winter	SP-6	4.000	S2-04	38.3	1.066	1.111	1.1931	
15 minute winter	S2-04	1.004	S2-05	191.8	1.739	1.359	6.8865	
15 minute winter	S2-05	1.005_1	S2-09-1	250.6	2.273	1.781	3.9892	
15 minute winter	SP-8	5.000	S2-08	30.8	1.025	0.892	1.3560	
15 minute winter	S2-08	5.001	S2-09	41.4	1.054	0.977	0.7953	
15 minute winter	S2-09	5.002	S2-05	49.5	1.278	0.903	0.4176	
2160 minute winter	S2-09-1	1.006	S2-10	17.9	0.860	0.108	0.3181	
2160 minute winter	S2-10	1.005	T2 - L1	16.7	1.922	0.047	0.1873	
2160 minute winter	S2-11	6.002	S2-09-1	3.5	0.324	0.021	0.7639	
2160 minute winter	S2-12	3.001	S2-11	2.8	0.566	0.040	2.0493	
2160 minute winter	S2-13	3.000	S2-12	1.3	0.325	0.033	1.1575	
2160 minute winter	T2 - L1	1.008	T2 - L2	10.2	0.034	0.001	529.8918	
2160 minute winter	T2 - L2	1.009	T3 - L1	3.5	0.740	0.007	5.8004	
2160 minute winter	T3 - L1	1.010	T3 - L3	3.6	0.026	0.000	432.9995	
2160 minute winter	T3 - L3	1.011	S2-36	28.9	0.565	0.047	0.2215	

Results for 100 year +20% CC Critical Storm Duration. Lowest mass balance: 99.97%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	S2-14	11	39.069	0.069	9.3	0.1061	0.0000	OK
2160 minute winter	S2-16	2040	39.049	0.319	1.2	0.4570	0.0000	SURCHARGED
15 minute winter	S2-15	10	39.197	0.051	9.3	0.0791	0.0000	OK
2160 minute winter	S2-17	2040	39.049	0.537	1.4	0.6859	0.0000	SURCHARGED
2160 minute winter	S2-18	2040	39.049	0.500	1.2	1.0350	0.0000	SURCHARGED
2160 minute winter	S2-19	2040	39.049	0.678	2.8	1.5053	0.0000	SURCHARGED
2160 minute winter	S2-20	2040	39.049	1.219	4.6	1.7818	0.0000	SURCHARGED
15 minute winter	S2_01	10	41.797	0.066	13.0	0.1044	0.0000	OK
15 minute winter	S2-22	10	41.276	0.091	27.4	0.1506	0.0000	OK
15 minute winter	S2-23	12	40.520	0.307	89.1	0.6421	0.0000	SURCHARGED
15 minute summer	S2-24	1	41.500	0.000	0.0	0.0000	0.0000	OK
15 minute winter	S2-25	11	41.094	0.094	35.5	0.1531	0.0000	OK
15 minute winter	SP-9	11	42.461	0.586	24.3	0.6534	0.0000	SURCHARGED
15 minute winter	SP-9-1	11	42.157	0.358	22.8	0.0000	0.0000	SURCHARGED
15 minute winter	SP-9-2	11	41.949	0.204	22.6	0.0000	0.0000	SURCHARGED
15 minute winter	S2-26	11	40.717	0.090	35.5	0.1014	0.0000	OK
15 minute winter	S2-27	12	39.206	0.381	12.2	0.5637	0.0000	SURCHARGED
15 minute winter	S2-32	12	39.180	0.780	108.7	1.3089	0.0000	SURCHARGED
2160 minute winter	S2-33	2040	39.049	0.783	6.0	1.0974	0.0000	SURCHARGED
2160 minute winter	S2-34	2040	39.049	0.824	6.3	1.1895	0.0000	SURCHARGED
2160 minute winter	S2-35	2040	39.049	0.863	6.6	1.2138	0.0000	SURCHARGED
1440 minute winter	S2-36	1410	39.046	1.348	25.6	1.9296	0.0000	SURCHARGED
2160 minute winter	S2-Intercept	2040	37.646	0.048	4.6	0.0544	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	S2-14	7.000	S2-16	9.0	0.742	0.115	0.4646	
2160 minute winter	S2-16	7.001	S2-17	1.2	0.434	0.012	1.8540	
15 minute winter	S2-15	8.000	S2-16	9.2	0.614	0.064	0.3868	
2160 minute winter	S2-17	7.002	S2-20	1.4	0.447	0.017	0.8072	
2160 minute winter	S2-18	9.000	S2-19	1.2	0.311	0.030	1.2018	
2160 minute winter	S2-19	9.001	S2-20	2.6	0.555	0.066	0.6424	
2160 minute winter	S2-20	7.003	T3 - L1	4.5	0.364	0.071	0.2103	
15 minute winter	S2_01	10.000	S2-22	12.8	1.040	0.188	0.3951	
15 minute winter	S2-22	10.001	S2-23	26.6	1.814	0.327	0.7118	
15 minute winter	S2-23	10.002	S2-32	84.8	2.174	0.862	2.0336	
15 minute summer	S2-24	11.000	S2-26	0.0	0.000	0.000	0.3820	
15 minute winter	S2-25	12.003	S2-26	35.5	2.341	0.290	0.1027	
15 minute winter	SP-9	12.000	SP-9-1	22.8	1.296	1.940	0.3017	
15 minute winter	SP-9-1	12.001	SP-9-2	22.6	1.285	1.904	0.2098	
15 minute winter	SP-9-2	12.002	S2-25	22.5	1.281	1.893	0.0603	
15 minute winter	S2-26	11.001	S2-23	35.4	1.499	0.318	0.2440	
15 minute winter	S2-27	13.000	S2-28	11.1	0.692	0.322	1.4052	
15 minute winter	S2-32	10.003	S2-33	104.0	1.477	1.330	1.8979	
2160 minute winter	S2-33	10.004	S2-34	5.8	0.551	0.072	0.5491	
2160 minute winter	S2-34	10.005	S2-35	6.2	0.570	0.086	0.6575	
2160 minute winter	S2-35	10.006	T3 - L3	6.5	0.642	0.083	0.2215	
1440 minute winter	S2-36	Hydro-Brake®	S2-Intercept	4.6				
2160 minute winter	S2-Intercept	1.013	S2-37	4.6	0.645	0.082	0.0321	

Results for 100 year +20% CC Critical Storm Duration. Lowest mass balance: 99.97%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
2160 minute winter	S2-37	2040	37.604	0.058	4.6	0.0657	0.0000	OK
2160 minute winter	S2-38	2040	37.486	0.034	4.6	0.0385	0.0000	OK
2160 minute winter	S2-39	2040	36.467	0.034	4.6	0.0000	0.0000	OK
15 minute winter	S2-28	12	39.189	0.521	21.9	0.5889	0.0000	SURCHARGED
15 minute winter	S2-29	12	39.183	0.577	23.1	0.6531	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
2160 minute winter	S2-37	1.014	S2-38	4.6	0.789	0.133	0.1250	
2160 minute winter	S2-38	1.015	S2-39	4.6	1.231	0.049	0.1162	1494.7
15 minute winter	S2-28	13.001	S2-29	23.1	0.994	0.579	0.4164	
15 minute winter	S2-29	13.002	S2-32	25.8	0.649	0.277	0.2574	